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Claims

1. A method for determining the roughness of a rolling surface of a tyre (11), comprising the step of:

5   - providing a first signal (Sa) representative of the motion of at least one point (P) of the tyre during its rolling on the surface,

- processing the first signal for providing an output (OU_L) indicative of the roughness of said

10 rolling surface of the tyre.

2. The method according to claim 1, wherein the processing step includes a frequency filtering step of the first signal (Sa) for extracting a second signal (S_{BP}) representative of motion components of said at

15 least one point due to the deformations undergone by the tyre during the rolling.

3. The method according to claim 2, wherein the processing step includes a data processing step of at least one portion ($\delta1$) of said second signal for

20 calculating at least one parameter indicative of the roughness of the rolling surface.

4. The method according to claim 1, wherein the first signal (Sa) is an acceleration signal representative of the acceleration of said at least

one point of the tyre during its rolling on the surface.

5. The method according to claim 4, wherein said acceleration signal is representative of at least one

5   of the following accelerations of at least one point of the tyre: radial acceleration, longitudinal acceleration, lateral acceleration.

6. The method according to claim 1, wherein the first signal is representative of the motion of said

10 at least one point (P) during a revolution of the tyre (11), said processing step including the steps of:

- determining first temporal/angular coordinates corresponding to a first portion of the first signal associated with a step of the rolling of the tyre

15 wherein said at least one point is in a zone of contact of the tyre (C-Z) with the rolling surface,

- determining at least one second temporal/angular coordinate corresponding to a second portion of the first signal associated with a step of

20 the rolling of the tyre wherein said at least one point is in a zone contiguous (IN-Z,; OU-Z) with said contact zone.

7. The method according to claim 6, wherein said contiguous zone is an input zone (IN-Z) which precedes

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said contact zone (C-Z) according to the sense of rotation of the tyre.

8. The method according to claim 7, wherein said inputzone (IN-Z) corresponds to an angular sector of the tyre having a preset angle of aperture.

9. The method according to claim 1, wherein the processing step includes an estimation step of the angular velocity of the tyre (11) during the rotation of the same.

10. The method according to claim 9, wherein the estimation step includes a calculation step of the angular velocity on the basis of at least one value of the centripetal acceleration of the tyre and on the basis of the radius of the tyre.

11. The method according to claims 3 and 6, wherein the processing step includes a definition step of said at least one portion ($\delta 1$) of the second signal (S_{BP}) on the basis of said temporal/angular coordinates, said at least one portion being correspondent to one between the contact zone (C-Z) and the contiguous zone (IN-Z).

12. The method according to claim 3, wherein the processing step includes the steps of:

-       filtering the first signal for extracting the second signal (S_{BP}),

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- carrying out an analogue digital conversion for obtaining digital data corresponding to said second signal,

- elaborating at least part of said digital
5 data and providing an output signal carrying the current parameter indicative of the roughness of the surface on which the rolling of the tyre occurs.

13. The method according to claim 12, wherein said elaborating step of at least part of the digital
10 data includes a calculation of a mean of values associated with a pre-selected number of digital samples.

14. The method according to claim 12, additionally comprising a data (a, b, c) pre-storage
15 step which defines at least one first reference curve representative of a first trend of the roughness parameters measured with the varying angular velocity of the tyre, the first reference curve being indicative of a first class of roughness associated
20 with a first reference rolling surface.

15. The method according to claim 14, additionally comprising an additional data (a, b, c) pre-storage step which defines a second reference curve representative of a second trend of roughness
25 parameters measured with the varying angular velocity

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of the tyre, the second reference curve being indicative of a second class of roughness distinct from the first class and associated with a second reference rolling surface.

5   16. The method according to claim 14, additionally including the steps of:

- receiving the output signal carrying the current parameter,

- receiving an additional output signal
10 indicative of the current angular velocity assumed by the tyre essentially during the measurement of the current parameter,

- performing a comparative elaboration of the current parameter with the values of said at least
15 first reference curve, in such a manner as to establish a roughness typology, to which the surface on which the rolling of the tyre is occurring belongs, essentially during the measurement of the current parameter, the comparative elaboration being carried
20 out by taking account of the present angular velocity.

17. A method for controlling the behaviour of a vehicle to which at least one tyre is mounted, comprising the steps of:

- determining an information relating to the
25 roughness of a rolling surface of the tyre (11) in

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accordance with a method according to at least one of the preceding claims,

- making available the information relating to the roughness to a vehicle control system.

18. The method according to claim 17, wherein said control system is an ABS (Anti Blocking System) system.

19. A system for determining the roughness of a rolling surface of a tyre (11) to be mounted onto a vehicle, the system being operatively associable with the tyre and comprising:

- a sensor device (3, 32) for providing a first signal (Sa) representative of the motion of at least one point (P) of the tyre during the rolling of said tyre on a surface having a respective roughness,

characterised in additionally comprising a processing stage (51, 2) of the first signal for generating an output (OU_L) indicative of the roughness of said tyre rolling surface.

20. The system according to claim 19, wherein the processing stage is of such a type as to perform a frequency filtering of the first signal (Sa) for extracting second signal (S_{BP}) representative of components of motion of said at least one point due to deformations undergone by the tyre during rolling.

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21. The system according to claim 20, wherein the processing stage is of such a type as to perform an elaboration of at least one part of said second signal for calculating at least one parameter indicative of
5   the roughness of the rolling surface.

22. The system according to claim 19, wherein said sensor device includes an accelerometer and the first signal (Sa) is an acceleration signal representative of the acceleration of said at least
10 one point of the tyre during rolling on the surface.

23. The system according to claim 22, wherein said acceleration signal is representative of at least one of the following tyre accelerations: radial, longitudinal, lateral.

15 24. The system according to claim 19, wherein the first signal is representative of the motion of said at least one point (P) during one revolution of the tyre (11) and the processing stage (54, 53, 34) is so as to process the first signal (Sa) in order to
20 determine temporal/angular coordinates corresponding to:

- a first portion of the first signal associated with a rolling step of the tyre wherein said at least one point is found in zone of contact (C-Z) with the
25 surface,

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- a second portion of the first signal associated with a rolling step of the tyre wherein said at least one point is found in a zone contiguous (IN-Z,; OU-Z) to said contact zone.

25. The system according to claim 24, wherein said contiguous zone is an input zone (IN-Z) which precedes said contact zone (C-Z) according to the sense of rotation of the tyre.

26. The system according to claim 25, wherein said input zone (IN-Z) corresponds to an angular sector of the tyre having a prefixed angle of aperture.

27. The system according to claim 19, wherein the processing stage is so as to estimate the angular velocity of the tyre (11) assumed during the rotation of the same.

28. The system according to claim 27, wherein the processing stage is so as to estimate the angular velocity on the basis of at least one centripetal acceleration value of the tyre and on the basis of a tyre radius.

29. The system according to claims 21 and 24, wherein the processing stage is so as to identify said at least one portion (δ1) of the second signal (S_{BP}) on the basis of said temporal/angular coordinates, said

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at least one portion being correspondent to one between the contact area (C-Z) and the contiguous area (IN-Z).

30. The system according to claim 21, wherein said processing stage includes a band pass filtering block (52) for providing said second signal by starting from the first signal.

31. The system according to claim 30, additionally comprising:

    - an analogue-digital converter (53) for obtaining digital data corresponding to said second signal (S_{BP}) and having associated a prefixed sampling frequency,

    - a memory device (35) for storing at least said digital data.

32. The system according to claim 31, wherein said processing stage includes a processing unit (34) for elaborating at least part of said digital data and provide the at least one parameter indicative of the roughness of the rolling surface.

33. The system according to claim 30, wherein said band pass filtering block (52) has a passing band comprised of between 300 Hz and 5000 Hz.

34. The system according to claim 33, wherein said band pass filtering block (52) has a passing band

comprised of between 300 Hz and 2500 Hz.

35. The system according to claim 30, wherein said filtering block includes at least one tracking filter (56, 57) having a respective cut-off frequency (f_l, f_u) modifiable as a function of the angular velocity of rotation of the tyre and correlated with a factor dependent on the number of block patterns present on the tread of said tyre.

36. The system according to claim 29 and 32, wherein said at least one portion of the samples to be processed by the processing unit is determined as a function of said sampling frequency and as a function of the extension of one between said contiguous zone and said contact zone.

37. The system according to claim 19, wherein said sensor device is predisposed to being fixed to the tyre.

38. The system according to claim 36, additionally comprising a transmission device (31) connected to said processing stage (51) and equipped with a first antenna (37) in order to irradiate at least one external signal.

39. The system according to claim 38, wherein said at least one external signal carries the information content of the first signal.

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40. The system according to claim 38, wherein said at least one external signal carries information indicative of the roughness of the tyre rolling surface.

5   41. The system according to claim 38, wherein said at least one external signal includes a velocity signal representative of the present angular velocity of the tyre during its rolling.

42. The system according to claim 39,
10 additionally comprising:

-      a fixed unit (2) installable on a vehicle and including a second antenna (25) coupled to a reception device (25) in order to receive said external signal;

15   -   an additional processing unit connected to a reception device in order to process the external signal received.

43. The system according to claim 19, wherein said sensor device is predisposed for being fixed to a
20 supporting rim (12) of the tyre.

44. A tyre (11) for a vehicle, comprising a sensor device (3) operatively associated with the tyre for providing a first signal (Sa) representative of the motion of at least one point (P) of the tyre
25 during the rolling of said tyre on a surface having a

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respective roughness,

characterised in that said sensor device comprises a processing stage (51) of the first signal for generating an output (OU$_L$) indicative of the

5   roughness of said tyre rolling surface.

45. A tyre according to claim 44, wherein the processing stage is so as to perform a frequency filtering of the first signal (Sa) for extracting a second signal (S$_{BP}$) representative of motion components

10   of said at least one point due to deformations undergone by the tyre during rolling.

46. A tyre according to claim 45, wherein the processing stage is so as to perform the processing of at least one portion of said second signal for

15   calculating at least one parameter indicative of the roughness of the rolling surface.

47. A tyre according to claim 45, wherein said sensor device includes an accelerometer (32) and the first signal (Sa) is an acceleration signal

20   representative of the acceleration of said at least one point of the tyre during rolling on the surface.

48. A tyre according to claim 47, wherein said acceleration signal is representative of at least one of the following tyre accelerations: radial,

25   longitudinal, lateral.

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49. A tyre according to claim 44, wherein the sensor device comprises a casing, fixed to one wall of the inside of the tyre by means of a fixing element (332).

5   50. A tyre according to claim 44, including at least one additional sensor device operatively associable with the tyre for providing an additional correspondent signal (Sa) representative of the motion of at least one additional point of the tyre during

10   the rolling of said tyre on the surface.

51. A wheel comprising a supporting rim (12) and a tyre (11) in accordance with at least one of the claims 44 to 50 associated with said supporting rim.